[DOCUMENT NAME] SPECIFICATION

Japanese Patent Application
Laid-Open No. 10-315493

[TITLE OF THE INVENTION]

INK JET IMAGE FORMING DEVICE

[DETAILED DESCRIPTION OF THE INVENTION]

[0001]

[Field of the Invention]

The present invention relates to an ink jet image forming device such as a printer and a copier, in which fine ink droplets are ejected onto a recording medium such as paper to form an image.

[0002]

[Prior Art]

Prior arts of this field will be described with respect to an ink jet printer in which ink droplets are ejected from small openings by means of varied pressure and the like.

[0003]

Ink jet printers of this kind can be classified into two types: printers with an integrated disposable ink cartridge which includes an ink jet recording head ("head" hereinafter) with a mechanism for ejecting ink, and ink; and printers with a head which needs no replacement and an ink cartridge that are provided separately, in which ink is supplied to the head by other means such as a pump.

[0004]

In a printer with a head which needs no replacement and an ink cartridge, an ink tank is provided between the head and the ink cartridge. With the ink tank, ink is generally supplied first from the ink cartridge to the ink tank and then supplied to the head so that the ink is not supplied directly to the head by other means such as a pump.

[0005]

A predetermined amount of ink is always stored in the ink tank to avoid air bubbles entering an ink flow path. The ink tank is provided with a residual ink detecting means which informs that the amount of the residual ink becomes less. In accordance with the detection result of the residual ink detecting means, ink is supplied from the ink cartridge to the ink tank.

[0006]

[Problems to be Solved by the Invention]

These conventional printers have some problems. A sufficient amount of ink is not always stored in the ink tank and the amount of ink in the ink tank sometimes becomes under a level at which the detecting means detects "run out" of ink. In such a case, when ink is used for, for example, forming images and for cleaning head in which the ink is fed to the head using other means such as a pump to stabilize ink ejection of the head, the detecting means may generate a signal of ink "run out" during above operations.

[0007]

In this case, to avoid causing deficiency to the image due to insufficient ink, the image forming operation needs to be temporarily interrupted. During the interruption, the ink is fed from the ink cartridge to the ink tank, which requires extra time before the operation is resumed.

[0008]

The present invention has been devised in view of the above facts and an object thereof is to provide means for solving the problems.

[0009]

[Means for Solving the Problems]

The object will be achieved by an ink jet image forming device set forth in any of (1) through (4) below.

[0010]

(1) An ink jet image forming device comprising: an ink jet recording head for forming an image; ink storage means for storing ink used for recording the image; and ink supply means for refilling the ink storage means with ink, wherein the ink supply means refills the ink storage means with ink while information required for forming the image is being processed.

[0011]

(2) An ink jet image forming device according to (1), wherein the ink supply means refills the ink storage means with ink also after the image is formed.

[0012]

(3) An ink jet image forming device comprising: an ink jet recording head for forming an image; ink storage means for storing ink used for recording the image; and ink supply means for refilling the ink storage means with ink, wherein a total ink supply period in which the ink supply means refills the ink storage means with ink while information required for forming the image is being processed and after the image is formed is previously determined.

[0013]

(4) An ink jet image forming device comprising: an ink jet recording head for forming an image; ink storage means for storing ink used for recording the image; and ink supply means for refilling the ink storage means with ink, wherein an ink supply period in which the ink supply means refills the ink storage means with ink after the image is formed changes in accordance with the length of an ink supply period in which the ink supply means refills the ink storage means with ink while information required for forming the image is being processed.

[0014]

[Operation]

In the present invention having above-described structure, ink is supplied while an operator is waiting for a next operation of the image forming device, e.g., during a period between power turning-on and a next operation, during development of image data, and after the image is formed. Other operations may be performed while the ink is being supplied. Since the ink tank

is continuously refilled with ink until the ink stored in the ink cartridge is detected to be "run out", the image forming device can be operated without any interruption while forming images or cleaning the head.

[0015]

[Embodiments]

Referring to drawings, embodiments of the present invention will be described in detail with respect to examples.

[0016]

[Examples]

First embodiment

Fig. 1 shows a simplified flow diagram of an ink jet printer relating to the first embodiment of the present invention.

[0017]

In Fig. 1, the ink jet printer includes an ink jet recording head 1, an ink recovery tank 2, an ink cartridge 3, an air inlet 4, a discharged ink storage 5, a main tank 12, a sub tank 15, a residual ink detecting means 16 and a sub tank opening and closing lever 17.

[0018]

The printer has three pumps 40, 50 and 60 which apply external pressure to ink to cause an ink flow. Operations which these pumps involve are as follows:

1. ink supply

2. pressurization, suction and circulation of ink

3. suction of discharged ink

[0019]

Referring to Fig. 1, these operations will be described.

(1) Ink supply

The ink stored in the ink cartridge 3 is fed to the main tank 12 in the printer. The opening and closing lever 17 is first moved in the direction of arrow A to close the sub tank 15. A pump I 40 is then rotated in the direction a to reduce pressure in a buffer 113, causing the ink 6 in the cartridge 3 to be fed into the buffer 113 through a needle 8, a tube 41 and a one-way valve 10.

[0020]

The sub tank 15 is then filled with ink fed through a tube 42. When a predetermined amount of ink enters the sub tank 15, the ink begins to return to the cartridge 3 through a tube 45 and a needle 7. Upon completion of the operation, the opening and closing lever 17 is moved in the direction of arrow B to open the sub tank 15 to air.

[0021]

(2) Pressurization, suction and circulation of ink

The ink in the main tank 12 is fed to the head 1. The pump I 40 is rotated in the direction b to pressurize the ink, causing the ink in the sub tank 15 to be fed into the buffer 113 through the tube 42, and then into the head 1

through the one-way valve 11, tubes 43 and 44. The one-way valve 10 prevents the ink from returning to the cartridge 3.

[0022]

A pump II 50 also is rotated in the direction c to suck the ink from the head 1 through tubes 53 and 52, and via a buffer 214 so that the ink is returned to the sub tank 15. Difference in capability and rotating time between the pump I 40 and the pump II 50 causes the ink to be discharged from the head 1 (discharged ink 20).

[0023]

(3) Suction of discharged ink

The discharged ink 20 produced during the process of pressurization, suction and circulation is then discharged from the head 1 into the recovery tank 2. A pump III 60 is rotated in the direction d to feed the discharged ink 20 into the discharged ink storage 5 in the cartridge 3 through a tube 61 and a needle 9.

[0024]

In a normal image forming operation, the ink ejected from the head 1 is transferred onto a recording medium such as paper to form an image. The ink is fed from the sub tank 15 through tubes and buffers. The ink used in the head 1 is continuously supplied from the sub tank 15 via capillary attraction.

[0025]

In conventional systems, the ink level in the sub tank 15 drops at the event of pressurizing and sucking of ink and image forming. When the ink level becomes under a residual ink detecting surface 18, a residual ink detecting means 16 determines that the ink in the sub tank 15 is "run out". Then the operation is interrupted by the ink supply, which causes interruption in image forming operation and requires an extra time. In the present embodiment, however, ink is supplied while the printer is in a standby state, e.g., during development of image data, and after the image is formed.

[0026]

Fig. 2 is a flow chart showing an ink supply operation sequence of the present embodiment.

[0027]

When the printer is on standby, data indicating to start image formation and image data is first input at step S1. While the image data is being developed at step S2, ink supply is started at step S3. If the development of the image data is not completed while the ink is being supplied at step S4, the process returns to step S4. Upon completion of development of the image data, the ink supply routine stops at step S6.

[0028]

Next, an image forming process begins at step S7 and stops at step S8. Ink supply is then started at step S9, continued at step S10, and stopped at step S11. Then the printer turns to the standby state.

[0029]

As shown in Fig. 2. the image forming device of the present embodiment is characterized in that, while the image data is developed, the ink is supplied until the development completes, and after the image is formed, the ink is supplied for predetermined period of time.

[0030]

Second embodiment

In the first embodiment, as shown in Fig. 2, while the image data is developed at step S2, the ink is supplied until the development completes at step S5, and after the image is formed, the ink is supplied for predetermined period of time. In the second embodiment, however, as shown in the flow chart of Fig. 3 illustrating ink supply operation sequence, the ink supply during development of image data (step S22) is continued regardless of completion of development of image data (step S26). That is, the ink is continuously supplied for a predetermined period of time t_1 which begins at step S23 and ends at step S25. The ink is also supplied for a period of time t_2 (from step S9 to step S31) after the image formation is completed at step 28. The total supply time T ($T=t_1+t_2$) is set longer than the period of time in which the sub tank 15 can be completely filled with ink.

[0031]

In the second embodiment, $T = t_1$ {the time period during which ink supply is started at step S23, continued at step S24, and stopped at step S25} + t_2

{the time period during which ink supply is started at step S29, continued at step S30, and stopped at step S31}.

As described above, the second embodiment is an image forming device characterized in that the ink is supplied along the sequence flow chart of Fig. 3.

[0032]

Third embodiment

In the second embodiment shown in Fig. 3, the ink supply time T, which is the total time of t_1 during which the ink is supplied while the image data is developed and t_2 during which the ink is supplied after the image formation is completed, is set to a predetermined time. In the third embodiment, as shown in the flow chart of Fig. 4 illustrating ink supply operation sequence, supposing that t_1' is an undefined period of time in which the ink is supplied, which begins when image data is developed at step S42 and ends when the development is completed at step S45, and T is a period of time in which the sub tank 15 can be completely filled with ink, then the period of time t_2' in which the ink is supplied after the image formation is completed is determined by the following equation.

[0033]

$t_2' = T$ {the time period during which the sub tank is completely filled with ink} + t_1' {the time period during which ink supply is started at step S43, continued at step S44, image data is developed at step S45, and ink supply is stopped at step S46}

As described above, the third embodiment is an image forming device characterized in that the ink is supplied along the sequence flow chart of Fig. 4.

[0034]

[Effects of the Invention]

As described above, in the present invention, ink is supplied during development of image data and after the image is formed in the ink jet image forming device. Accordingly, the ink can be continuously supplied without causing either an operator to stop operation or wasting time.

[BRIEF DESCRIPTION OF THE DRAWINGS]

[Fig. 1]

Fig. 1 is a simplified flow diagram of an ink jet printer relating to a first embodiment of the present invention.

[Fig. 2]

Fig. 2 is a flow chart showing an ink supply operation sequence of the first embodiment of the present invention.

[Fig. 3]

Fig. 3 is a flow chart showing an ink supply operation sequence of a second embodiment of the present invention.

[Fig. 4]

Fig. 4 is a flow chart showing an ink supply operation sequence of a third embodiment of the present invention.

[Description of the Reference Numerals]

1: ink jet recording head

2: recovery tank

3: ink cartridge

4: ink cartridge air inlet

5: discharged ink storage

6: ink stored in cartridge

7, 8, 9: needle

10, 11: one-way valve

12: main tank

13: buffer 1

14: buffer 2

15: sub tank

16: residual ink detecting means

17: opening and closing lever of sub tank

18: residual ink detecting liquid surface

20: discharged ink

40: pump I

50: pump II

60: pump III

41, 42, 43, 44, 45, 51, 52, 53, 61: tube

[DOCUMENT NAME] ABSTRACT OF THE DISCLOSURE

[SUMMARY]

[OBJECT]

To solve a problem in an ink jet image forming device, in that when an residual ink detecting means informs that ink in the ink tank is "run out", the device temporally stops image forming operation to supply ink to the ink tank, which requires extra time before the operation is resumed.

[MEANS FOR SOLUTION]

Ink is supplied while an operator is waiting for a next operation of the image forming device, e.g., during a period between power turning-on and a next operation, during development of image data, and after the image is formed. Other operations may be performed while the ink is being supplied.

[SELECTED FIGURE]

Fig. 1

FIG. 2: FLOW CHART OF INK SUPPLY OPERATION SEQUENCE OF FIRST EMBODIMENT

PRINTER STANDBY

S1: DATA INDICATING TO START IMAGE FORMATION AND IMAGE DATA IS INPUT

S2: IMAGE DATA IS DEVELOPED

S3: INK SUPPLY IS STARTED

S4: INK SUPPLY IS CONTINUED

S5: DEVELOPMENT OF IMAGE DATA COMPLETED?

S6: INK SUPPLY IS STOPPED

S7: IMAGE FORMING IS STARTED

S8: IMAGE FORMING IS COMPLETED

S9: INK SUPPLY IS STARTED

S10: INK SUPPLY IS CONTINUED

S11: INK SUPPLY IS STOPPED

PRINTER STANDBY

FIG. 3: FLOW CHART OF INK SUPPLY OPERATION SEQUENCE OF SECOND EMBODIMENT

PRINTER STANDBY

S21: DATA INDICATING TO START IMAGE FORMATION AND IMAGE DATA IS INPUT

S22: IMAGE DATA IS DEVELOPED

S23: INK SUPPLY IS STARTED

S24: INK SUPPLY IS CONTINUED

S25: INK SUPPLY IS STOPPED

S26: DEVELOPMENT OF IMAGE DATA IS COMPLETED

S27: IMAGE FORMING IS STARTED

S28: IMAGE FORMING IS COMPLETED

S29: INK SUPPLY IS STARTED

S30: INK SUPPLY IS CONTINUED

S31: INK SUPPLY IS STOPPED

S32: PRINTER STANDBY

T: TIME PERIOD IN WHICH SUB TANK IS COMPLETELY FILLED WITH INK

$t_1+t_2=T$

FIG. 4: FLOW CHART OF INK SUPPLY OPERATION SEQUENCE OF THIRD EMBODIMENT

PRINTER STANDBY

S41: DATA INDICATING TO START IMAGE FORMATION AND IMAGE DATA IS INPUT

S42: IMAGE DATA IS DEVELOPED

S43: INK SUPPLY IS STARTED

S44: INK SUPPLY IS CONTINUED

S45: DEVELOPMENT OF IMAGE DATA COMPLETED?

S46: INK SUPPLY IS STOPPED

S47: IMAGE FORMING IS STARTED

S48: IMAGE FORMING IS COMPLETED

S49: INK SUPPLY IS STARTED

S50: INK SUPPLY IS CONTINUED

S51: INK SUPPLY IS STOPPED

PRINTER STANDBY

T: TIME PERIOD IN WHICH SUB TANK IS COMPLETELY FILLED WITH INK